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ABSTRACT

A correspondence is suggested between the two different abilities underlying performance on intellectual or learning tasks discussed by Jensen and the two response processes postulated by various mediational models of discrimination learning. To test this, two groups of nursery school children differentiated by the measurable social class of their families were given discrimination training. One half of those in each social class group then experienced an intradimensional shift in discrimination transfer operation, with the remainder experiencing an extradimensional shift. After administration of object discrimination problems to the children, data indicate that some correlate of social class is related to performance in discrimination transfer problems. White upper class nursery school children performed at a level superior to white lower class nursery school children, and the difference occurred in spite of a lack of difference in testable IQ. The deficiency appears to be related to differences in mediational ability and is consistent with Jensen's two-ability model. (LH)

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SOCIAL CLASS DIFFERENCES IN DISCRIMINATION TRANSFER IN NURSERY SCHOOL CHILDREN[1]

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In 1969, Jensen postulated the existence of two genetically distinct but functionally related abilities which underlie performance on intellectual or learning tasks. Level I abilities are described as being "associative" in nature and are operationally anchored to tasks such as digit span and serial learning tasks. Level II abilities are mediational in natuer, are related to the subjects' ability to engage in self initiated activity, and are operationally anchored to cross-modal transfer tasks or clustering in free recall.

The noteworthy characteristics of Jensen's notions were the postulated differences in the distribution of these abilities as a function of social class variables. Thus, Jensen postulated that while Level I abilities were equally distributed in both upper and lower social classes, the mean of the distribution of Level II abilities in children from lower class families is shifted down relative to upper class children.

Mediation models of discrimination learning similarly postulate two distinct but functionally related response processes which must occur during solution of a discrimination problem. Zeaman and House (1963) postulate a

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2 The authors extend their appreciation to the directors, teachers, and children of the nursery schools at the First Presbyterian Church, St. Peter's United Church of Christ and Head Start Program of Lancaster. Special recognition and sincere thanks are also given to Mrs. E. Jesse Neely for the monumental task of data collection and reduction which was so well done.

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chain of responses consisting of an "observational" or "attentional" response which is made to a stimulus dimension and an instrumental response which is directed at a specific stimulus cue. According to their model, during the solution of a discrimination problem the subject must first learn to observe or pay attention to the relevant stimulus dimension (e.g., form, color) and then instrumentally respond by selecting the correct cue (e.g., square or red) of that relevant dimension. In a similar fashion, the Kendlers (1962) have postulated the acquisition of a covert verbal response which mediates stimulus reception and response occurrence.

In the present paper it is suggested that there exists a correspondence between the two different abilities discussed by Jensen and the two response processes postulated by the various mediational models of discrimination learning. Specifically, Level I ability is assumed to correspond to the rate of instrumental or choice response learning while Level II ability would be the analogue of the attentional or verbal mediational response acquisition rate.

This hypothesized correspondence holds an advantage experimentally, since there are several operations which are known to alter the rate of discrimination learning which are attributable to the effect of the mediational (attentional) mechanism. Perhaps the best known and replicable of these are the discrimination transfer operations of intradimensional (ID) versus extradimensional (ED) shifts. The ease of learning the second of two discrimination problems depends to a large extent upon the consistency of the relevant dimension over the two problems. Thus, if the subject experiences two form relevant problems with different forms in each problem (an ID shift), he will acquire the second problem much more rapidly than if the relevant dimension is switched from form in Problem 1 to color in Problem 2 (an ED shift).

If there is a correspondence between the attentional (mediational) response of Zeaman and House and the Level II (mediational) ability of Jensen, and if Jensen's assumption that the mean of the distribution of Level II ability in lower class children is below that of higher class children, then a comparison of intradimensional and extradimensional shift effects should produce differential results as a function of the social class of the children.

The design appropriate to test these notions is a 2 (social class) x 2 (type of shift) analysis of variance. Thus, in the present experiment two groups of nursery school children differentiated by the measurable social class of their families were given discrimination training. One half of the children in each social class group then experienced an ID shift with the remainder experiencing an ED shift.

Finally, to assess the extent to which any differences may persist over a series of such shifts -- or alternatively, to assess the rate at which children learn-to-learn successive ID or ED shifts -- the experiment was expanded to a 2 (social class) x 2 (type of shift) x 5 (shift problems), with each child experiencing a series of 5 transfer problems following the original learning.

Method

Subjects.--Approximately 200 children attending either a private church-related nursery school or a federally-funded Head Start nursery school in Lancaster, Pennsylvania, were administered the Peabody Picture Vocabulary Test (PPVT) and the Hollingshead Two-factor Index of Social Class. From this total pool, 4 groups of caucasian, English speaking children were formed such that all groups were equated on MA, IQ, CA, and PPVT raw score. Two of these groups were high on the Hollingshead Index of Social Class, while the other two were low. Table 1 on the handout presents the relevant statistics for all groups as well as the analysis of variance demonstrating significant social class differences. No other differences approached significance.

Procedure.--All subjects were administered a series of six two-choice, object discrimination problems. One of the two groups of children at each social class level experienced an original training problem and 5 successive problems in which the same dimension was relevant over all problems (intra-dimensional shifts); one half of each group experienced 6 form problems and the rest 6 color problems.

The remaining two groups of children experienced a change in relevant dimension following each of the 6 problems (extradimenaional shifts). One half of each group began with a form relevant problem and the remainder began with a color relevant problem. In each case the relevant dimension alternated between color and form over the problem series.

All problems had a variable-within irrelevant dimension and were administered via a non-correction procedure on a portable WGTA at the rate of 25 trials per day. Stimuli for each successive problem for each subject were selected randomly from a pool of 36 objects. There were six forms (square, circle, triangle, cross, T, diamond) in each of six colors (red, green, yellow, black, white, blue) cut from ¼" masonite and mounted vertically on masonite bases. The same stimuli were not used on two successive problems.

All children were run to a criterion of 20 correct trials in a daily session. If a child did not attain criterion in 150 trials, a special training technique was instituted (Eimas, 1966). Prior to administering the test trials on the day following this failure criterion, the positive stimuli were displayed and the child was told that these would always hide the candy. Then, the two negative stimuli were displayed and the child was told that these would not ever hide the candy. The transfer problem was initiated on the day following criterion attainment.

Results.--The major dependent variables were trials and errors to criterion. Since analysis of both yields identical results, for brevity, only errors will be discussed. The results are presented in Table 3 of your handout and the analyses are summarized in Table 4 of the handout.

A 2 (social class) x 2 (type of shift) analysis of variance on original learning demonstrated no significant differences between any of the groups. A similar analysis of the first transfer problem yielded a significance shift effect ($F=10.79$; $df=1,28$; $p<.005$), indicating that ID shifts are easier than ED shifts, and a significant social class x shift interaction ($F=4.85$; $df=1,28$, $p<.05$). The 2 (SEC) x 2 (shift) x 5 (transfer problems) analysis of variance demonstrated significant effects due to social class ($F=4.25$; $df=1,28$; $p<.05$) and shift ($F=8.92$; $df=1,28$; $p<.01$) with neither problems nor any interactions producing effects approaching significance. Figures 1 and 2 present the errors to criterion for the two social class groups and the two shift conditions over all problems. T tests for related groups were calculated on the difference in errors between problem 1 and problem 2 (savings scores) for each of the four groups and yielded a significant savings for intradimensional shift groups in high and low SEC conditions ($t=3.8$; $df=6$; $p<.01$ and $t=3.6$; $df=6$; $p<.01$) and in the high SEC extradimensional shift group ($t=3.3$; $df=6$; $p<.01$) but not in the low SEC extradimensional shift group ($t=.79$; $df=6$; $p>.10$). These data appear in Table 5.

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Discussion

In the first discrimination problem all children are assumed to have acquired both the correct attentional (mediational) response as well as the correct instrumental response. Since all the children are sampled from a population with the same Level I ability (rate of instrumental response learning) this should not affect performance differentially as a function of social class. However, since

lower class children have a lower Level II ability (i.e., rate of attentional response acquisition), the upper class children should acquire the discrimination more rapidly. This logic would predict a significant main effect of social class with higher class children learning more rapidly than lower class children. This did not occur. However, I think I can explain this by postulating a ceiling effect which prevented 9 children in each social class from acquiring the solutions without the special training following the failure criterion. This ceiling effect (problem difficulty) would conceal any differences which might exist. Naturally, an alternative interpretation is that the data reflects the fact of no social class differences in abilities relevant to this task.

The logic is not as straight forward for predicting an outcome on the second discrimination problem. At the conclusion of Problem 1, all children will have acquired the appropriate attentional (mediational) response as well as the correct instrumental response. All of the children then experienced a second problem in which there were totally new cues of both the form and color dimension. This means they all have to learn a new instrumental response so again this should have no differential between group effects. One half of the children in each social class group experienced an ID shift with the remainder experiencing an ED shift. Since the ID shift groups have already acquired the attentional response appropriate for the shift problem and, if they transfer that response across problems, they should learn the second problem rather rapidly. However, those subjects experiencing the ED-shift will have to extinguish this original attentional response and acquire a novel one (indeed, one which has undergone extinction on Problem 1); to the extent that lower class children have a decreased rate of acquiring this new attentional response they will experience more difficulty than the upper class children. This difference is reflected in the social class by shift interaction with the

lower class ED group performing below the level of the other groups. That interaction was significant and the lower class ED shift children experienced no significant positive transfer from Problem 1 to Problem 2, whereas children in all other groups did experience such positive transfer.

Looking at the data from all 5 transfer problems we see no significant improvement over the successive problems (excluding the improvement following problem I). However, the ID shift problems continue to be easier than ED shifts and, perhaps more surprisingly, lower class children are consistently making more errors than upper class children.

It appears that some correlate of social class -- not related to PPVT IQ test results -- is related to performance in discrimination transfer problems. One particularly likely candidate, in light of the present data, is the rate of acquisition of some implicit mediational ability. One final comment regards the difficulty these data present for a verbal mediational model such as the Kendler's. These children were below the age at which verbal mediation is typically present. Yet behavior indicative of mediation did occur.

In summary, white upper class nursery school children performed at a level superior to white lower class nursery school children in discrimination transfer tasks. This class difference occurred in spite of a lack of difference in testable IQ. Finally, this performance deficiency appears to be related to differences in mediational ability and is consistent with Jensen's two-ability model.

SOCIAL CLASS DIFFERENCES IN DISCRIMINATION TRANSFER IN NURSERY SCHOOL CHILDREN

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Table 1
Mean and Standard Deviation of PPVT Test Results, Chronological Age and Social Class Scores for all Groups

		HI SEC					LO SEC				
		PPVT Raw Score	PPVT MA	PPVT IQ	CA	Class Index	PPVT Raw Score	PPVT MA	PPVT IQ	CA	Class Index
ID	$\bar{X}$	49.5	62.7	104.0	54.1	17.9	46.4	56.7	100.0	53.7	62.0
	SD	9.7	18.1	17.8	4.1	4.1	8.1	11.6	14.5	5.9	13.5
ED	$\bar{X}$	46.0	58.5	101.5	53.7	20.6	42.5	52.0	93.9	54.3	64.2
	SD	11.4	16.6	15.8	8.6	8.0	10.8	13.2	23.1	6.0	9.2

Table 2
Summary Table of Analyses of Variance on Subject Characteristics

Social Class Index

	df	ms	f	
A (SEC)	1	15400.1	176.600	$p < .005$
B (SHIFT)	1	50.0	.570	
A X B	1	.5	.005	
Error	28	87.2		

Table 3
Mean Errors to Criterion for Each Experimental Group During Original and Transfer Problems

		Original Learning	Transfer #1	Transfer #1-#5 Combined
HI SEC	ID	51.9	7.4	3.8
	ED	68.1	15.5	14.4
LO SEC	ID	52.4	3.3	9.6
	ED	58.1	44.4	29.9

Table 4
Summary Tables for Analyses of Variance of Errors to Criterion Data

4(a) Original Learning -- no significant differences.

4(b) Transfer Problem #1

Source	ms	df	f	
A(Social Class)	1225.1	1	2.72	$p > .10$
B(Shift)	4851.1	1	10.80	$p < .005$
A X B	2178.0	1	4.85	$p < .05$
Error	449.3	28		

Table 4 (cont'd)

4(c) Total Transfer Problems

Source	ms	df	f	
A(Social Class)	4558.2	1	4.25	$p<.05$
B(Shift)	9579.0	1	8.93	$p<.01$
C(Problems)	256.9	4	.69	
A X B	940.9	1	.88	
A X C	284.7	4	.76	
B X C	590.0	4	1.57	
A X B X C	418.7	4	1.12	
Error bet. S	1072.9	28		
Error within	374.7	112		

Table 5
Mean Savings Score
(Errors on original -- Errors on transfer)

HI	ID	+ 44.5	$t = 3.87$	$p<.01$
	ED	+ 52.6	$t = 3.47$	$p<.02$
LO	ID	+ 43.5	$t = 3.61$	$p<.01$
	ED	+13.75	$t = .80$	$p>.10$

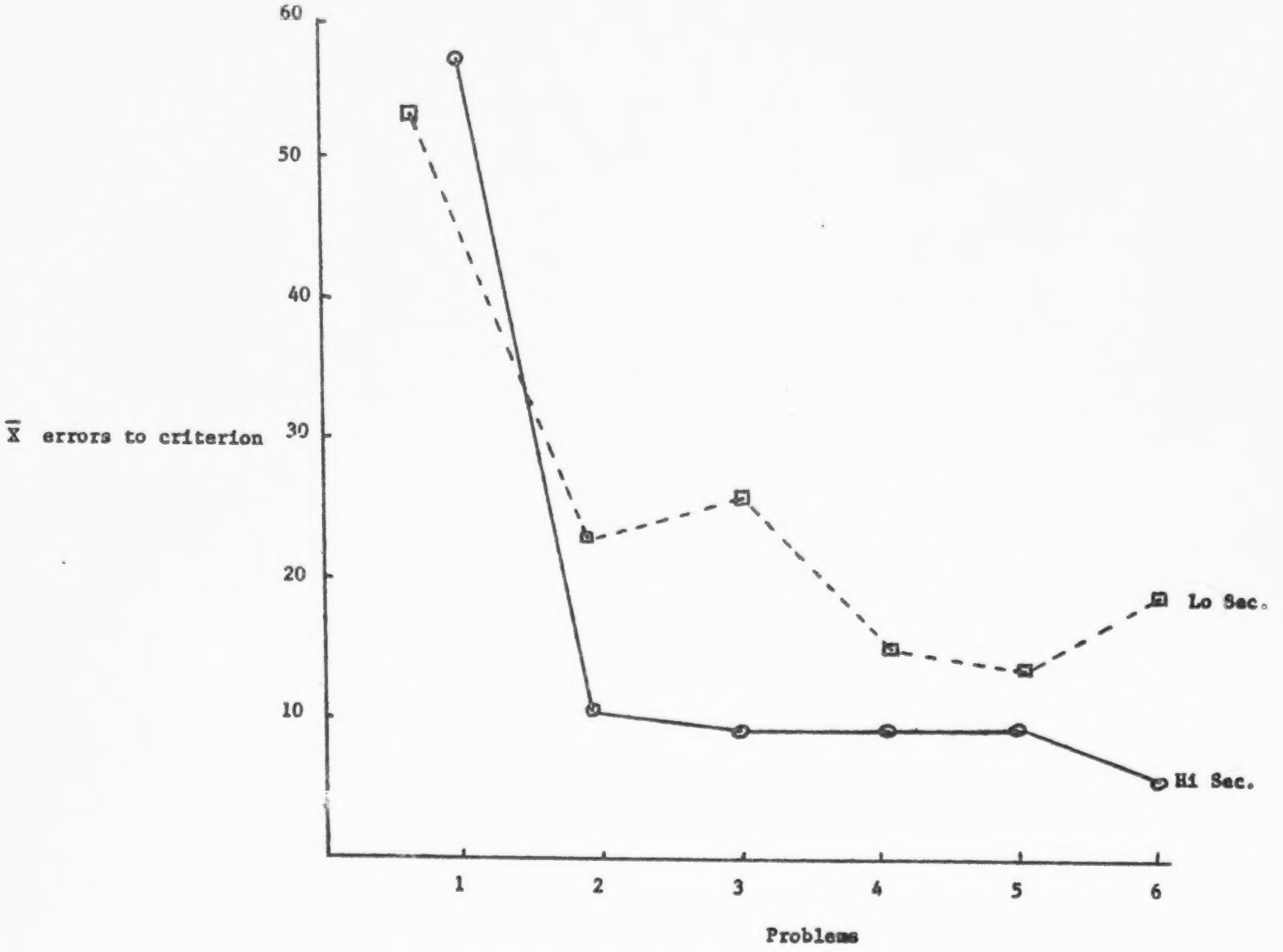

Figure 1. Mean errors to criterion for Hi and Lo social class subjects over all problems.

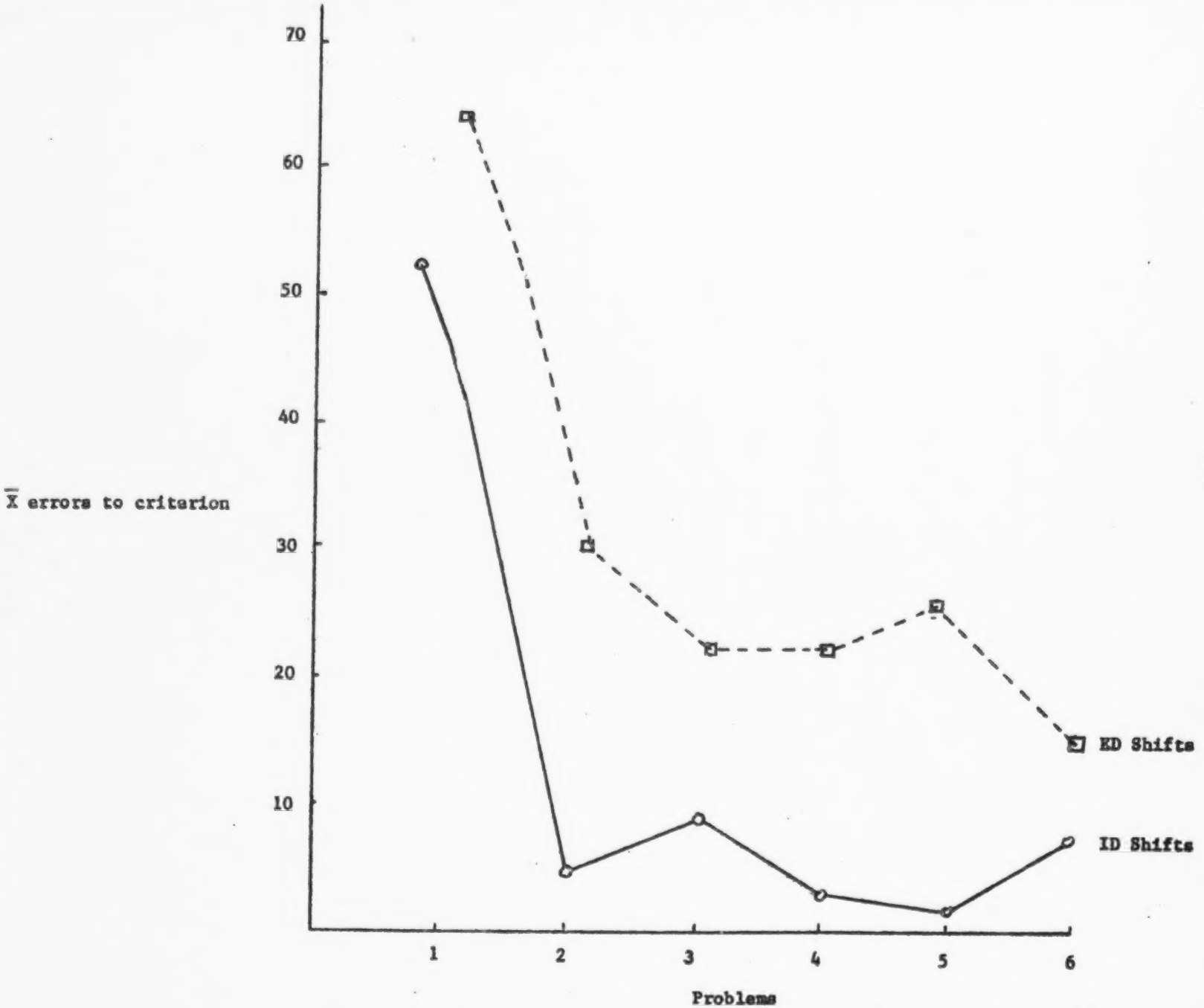

Figure 2. Mean errors to criterion for ID and ED subjects over all problems.